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ABSTRACT

This study sought to determine factors affecting retention of minority students in graduate and professional science degree programs. The study was a variation of Vincent Tinto's (1987) student retention model, which relates retention to complex interactions between social integration and academic integration. In this study, interviews were conducted with 14 students (4 Caucasian, 5 Hispanic, and 5 African American) who had completed the Summer Undergraduate Research Program at the University of Minnesota, which was designed to improve access to graduate and professional schools for undergraduate women and students of color. Respondents, who were currently enrolled in graduate school, had plans to enroll, or had graduated from graduate or professional programs, all indicated that the program had positively affected their academic program, choice of graduate or professional programs, and career choice. Respondents also rated as important the following program characteristics: advanced research experience, information about graduate and professional school programs, acclimatization to graduate research work, establishing close friendships with peers, and mentoring relationships with faculty and program administrators. Minority students noted the importance of positive relationship with peers and faculty. The findings support Tinto's premise that social integration is important in furthering student persistence. Nine data tables and figures are appended. (Contains 19 references.) (CH)

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Retaining Aspiring Scholars: Recruitment and Retention of Students of Color in Graduate and Professional Science Degree Programs

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This paper was presented at the annual meeting of the Association for the Study of Higher Education held in Albuquerque, New Mexico, November 6-9, 1997. This paper was reviewed by ASHE and was judged to be of high quality and of interest to others concerned with higher education. It has therefore been selected to be included in the ERIC collection of ASHE conference papers.

Retaining Aspiring Scholars: Recruitment and Retention of Students of Color in Graduate and Professional Science Degree Programs

Introduction

Background

Many observers contend that the United States must improve the quality of its education system in order to be competitive in an international environment. Several reports suggest a consensus among business leaders, academicians, and policy makers that higher levels of literacy in science, mathematics, and technology are essential to the future economic growth of the United States (Consortium for Policy Research in Education, 1995; Council on Competitiveness, 1995). America's failure to cultivate its human resources is having a deleterious effect on the nation's competitiveness in global markets, according to the Council on Competitiveness (1995), a private-sector coalition of chief executives from business, organized labor, and higher education.

Among the human resources that require cultivation are certain minority groups that remain under-represented in academic training programs and in professional positions in science and engineering, the fields cited as crucial for economic growth. In 1988, blacks and Latinos comprised 10% and 7% respectively of the United States employed labor force; however, they represented only 3% each of all employed scientists and engineers (National Science Foundation (NSF, 1990). The status of American Indians in science and engineering is somewhat less clear than that of other minority groups due to the difficulties in collecting data on a small population and in obtaining accurate reports of American Indian heritage on survey instruments (NSF, 1990).

Given these workforce statistics, industrial society needs, and the historical under-representation of Native Americans, Latinos, and African Americans in science and engineering, it is in the interest of the nation to educate more under-represented minority students and to

educate more of these students in the sciences. According to Dan Burton, President of the Council on Competitiveness, "The organization's latest report, Human Resources Competitiveness Profile, should drive home the need to focus on developing the nation's human resources, its people, to improve our long-term competitiveness and standard of living. We cannot afford to sacrifice anybody (1995, Corelink).

In calling for change that promotes greater participation of all groups in scientific endeavors, Henry Etzkowitz of the Sociology Board of the State University of New York at Purchase emphasized that the legitimization of science, the moral injunction to achieve equity, and the strategic national interest in utilizing talent to its fullest extent are reasons for change (Etzkowitz, 1994). Neal Lane, director of the National Science Foundation, has called upon the research community to act in its own self-interest and to make a conscious effort "to integrate itself into the larger community" by more closely reflecting the demographic composition of the population (Lane, cited in Etzkowitz, 1994).

This call for change has been previously sounded. In the late 1960s and early 1970s scientists, engineers, executives, educators, public policy makers and others ascertained that something needed to be done to reverse the disturbing trend that led to blacks, Latinos, and American Indians accounting for such a small percent of the country's scientists and engineers, even though they made up about 13% of the American workforce.

During this time period, officials from universities, scientific societies, and industry developed initiatives and began programs to address reversing this trend. The nation's major foundations began setting aside funds and advertising for proposals for projects to increase the number of minorities in science. Government itself became proactive. In the late 1960s, the

National Science Foundation inaugurated new programs and now estimates that it averaged about $100 million a year, or about $1.5 billion in the past 20 years, to increase the number of minorities in science. At the National Institutes of Health, officials estimated that two central minority programs absorbed about $675 million over the last two decades (Sims, 1992).

In terms of recruitment, these initiatives have been slightly effective in increasing the enrollment of African American, Hispanics and Native Americans. Retention has proven to be even more problematic. Seymour and Hewitt (1994) cite data from the Astins' 1993 longitudinal study indicating that while attrition from science, mathematics and engineering majors is 27% for white students, attrition is 50 to 60% for black, Latino and Native American students.

Definition of Terms

Under-representation: According to Blackwell (1981) representation is inextricably related to all of the processes that influence access as well as to efforts to meet compelling social need. For Blackwell, proportionality makes it a compelling urgency to train a sufficient number of black students at every level of education and to eliminate all social, economic, political, and institutional barriers to access so that black students can be admitted with the same regularity and expectations of accomplishment as other students who are admitted to graduate and professional schools. Blackwell was referring to black students only. This study extends the definition of under-representation to include black, Latino, and Native American students.

Black, African American: These terms are used interchangeably in this paper.

Hispanic, Latino: These terms are used interchangeably in this paper.

White, Caucasian: These terms are used interchangeably in this paper.

Students of Color, Minority Students: These terms are used interchangeably in this paper to refer to black, Latino and Native American students.

Under-represented Students of Color: The under-represented students of color considered in this study include blacks, Latino (specifically Mexican Americans, Puerto Ricans, and Hispanics from Central and South America who are U.S. citizens), and Native Americans (American Indians, Aleuts, Eskimos, Alaska Natives). Following the work of Matthews (1990), Asian Americans are excluded in this study primarily because they are not statistically under-represented in science, mathematics, and engineering. National Science Foundation data showed that Asian representation among doctoral scientists and engineers was greater than their representation among all scientists and engineers (NSF,1990).

Participation of Students of Color in Higher Education and Enrollment in Math and Science

Factors such as the school system's curriculum and tracking, student/parent misconceptions about the importance of advanced mathematics, teacher perceptions and expectations of students, students' attitudes and performance in the precollege curriculum are just some of the conditions in the K-12 pipeline that lead to only six percent of all minority students nationwide graduating from high school with the prerequisite sequence of mathematics and science courses to undertake college level mathematics, science or engineering degrees. Even with these constrictions in the elementary/secondary education pipeline, minority students have pursued baccalaureate degrees and advanced degrees in the sciences.

As reported in the 11th Annual Status Report on Minorities in Higher Education (1993), students of color made up a larger share of the total higher education enrollment nationwide in 1990 than in 1980. Demographic changes during this period resulted in increased numbers of

Hispanic, African American, American Indian, and Asian American students in higher education. The authors of the annual status report, Carter and Wilson (1993), indicated that at first glance the college enrollment growth among minorities during this decade seemed impressive. However, this upsurge in the number of minorities enrolled in college was reflective of their general population growth.

In a recent look at degree attainment in the social sciences, the natural sciences and engineering, the National Science Foundation reported that more science and engineering degrees are being earned by racial/ethnic minorities (NSF,1995). The report indicates the number of bachelor's degrees in science and engineering fields awarded to under-represented minority students showed robust growth in the early 1990s, after a period of slow growth from 1985 to 1990. From 1990 to 1993 the number of baccalaureate recipients with degrees in science and engineering increased 34% for blacks, 32% for Hispanics, and 43% for American Indians.

Even with this growth, minority students are still under-represented. Under-represented minorities comprised 28% of the "college-age" population (18-24 years old in 1993), whereas baccalaureates earned by under-represented minority students accounted for only 12% of the total science and engineering degrees in 1993 (NSF, 1995).

The proportionately small number of minority students (excluding Asian American students) initially enrolled as science and engineering undergraduate majors is well documented (College Board, 1985; NSF, 1990). If one looks only at college-bound seniors, however, white, black, Mexican American, Latin American, and Puerto Rican students are about equally likely to plan to enroll as science or engineering majors. American Indian students are somewhat less likely to do so (NSF, 1990).

Some Factors Influencing Enrollment: Student Numbers, Critical Mass and Isolation

On campuses of major research institutions, minority students most often encounter the situation of being one or few in number in their majors and classes. Etzkowitz (1994) states that a minority group (especially one that has traditionally been discriminated against) is easily marginalized when they are only a small presence in a larger population; their continued presence and survival is in constant jeopardy, requiring outside intervention and assistance to prevent extinction. As the group's presence and level of participation grows, at a particular point the perspective of members of minority group and the character of relations within the minority group and the character of relations between minority and majority group changes qualitatively. Etzkowitz continued to say that, in theory, the minority is increasingly able to organize itself and insure its survival from within. The minority group effects a transition to an accepted presence, without external assistance, in a self-sustaining process. The discrete point at which the presence of a sufficient number brings about qualitative improvement in conditions and accelerates the dynamics of change is known as "critical mass" and has been defined as a strong minority presence of at least 15%.

According to Seymour and Hewitt (1994), the small number of students of color to be found in science, mathematics and engineering classes, in itself, creates difficulties for those few who enter them. Students of color lack peers, faculty role models and mentors (Brown, 1994; Thomas, Clewell and Pearson, 1992, cited in Seymour and Hewitt 1994). Isolation is widely recognized as a problem for women in academic science, carrying with it a variety of negative consequences including stigma, depletion of self-confidence, and exclusion from access to informal sources of professional information. Informal networks are indispensable to

professional development, career advancement, and the scientific process. Contiguity of helpful colleagues improves the conditions for scientific achievement; lack of sympathetic interaction depresses it. Isolated individuals not only lack social psychological support, but also the social capital underlying success. As outsiders, some female scientists develope strategies to make up for these deficits (Etzkowitz, 1994). While Etzkowitz referenced women in academic subjects, the same challenges to advancement in a scientific or professional career characterize the efforts of students of color. As Pearson observed because they are forced to "learn in isolation," students of color do not have the same educational experience as white male peers (Science, 1992). Black women, in particular, complain they are often the only minority students (and often the only woman) in their science, mathematics and engineering classes (Brown, 1994; Science, 1992). In summary, with many factors contributing to low enrollment and graduation, minority students continue to earn extremely low proportions of science and engineering doctorates.

Problem Summary and Research Question

The educational experiences of minorities at all levels differ extensively from each other and from those of majority students. Within the context of students' elementary and secondary education, factors have been identified that contribute to minority students not performing as well as majority students. Once in college, women and minorities continue to participate in science and engineering programs at lower rates than male and majority students.

In spite of major efforts and expenditures of millions of dollars over the past 20-25 years, retention of African-American, Hispanic and Native American students in the science, mathematics and engineering pipeline has proven problematic. With the under-representation of

minority groups in the sciences, this study asks. "What retains minority students in the pipeline leading to graduate/professional science degrees?"

Theoretical Framework for the Study

Conceptual and theoretical models have been developed to address recruitment and retention of students in higher education`s academic programs at the undergraduate and graduate levels. A theoretical student retention model developed by Vincent Tinto (1987) emphasized the importance of factors supporting social and academic integration for student success in higher education. Tinto's model (figure 1) considers the many and complex reasons for student attrition or retention. The model has withstood careful scrutiny from the profession and has been accepted as the most useful for explaining the causes of student outcomes. His work describes the complex interactions between background characteristics and the campus environment, positing that the fit between the student and the environment involves both social and academic integration in the institution. **Social integration** relates to involvement with peers, faculty and campus activities, while **academic integration** relates to academic performance, involvement with the curriculum, and contact with faculty and staff. Tinto suggested that when a student experiences integration, that student is more likely to persist. Importantly, lack of fit -- or incongruence -- occurs when the individual views himself or herself "at odds with the institution," a phrase that comes very close to describing the concept of alienation (Babbit, Bruback and Thompson, 1975; Bradock, 1978; Loo and Rolison, 1986 cited in Smith 1989). The specific model (Figure 2) reported on in this study is a variation of Tinto's model that looks at personal-normative integration aspects of the University of Minnesota's Life Sciences' Summer Undergraduate Research Program.

Design of the Study

Description of the Site

The site for the study was the Life Science's Summer Undergraduate Research Program (SURP) at the University of Minnesota. The program is a recruitment and retention effort at the University of Minnesota that emphasized improving access to graduate and professional schools for women and students of color. The program is considered typical and representative of many comparable programs at other research universities. The Summer Undergraduate Research Program was initiated by faculty and staff in the College of Biological Sciences (CBS) as part of a major effort to address society's need for increased diversity in the pool of trained biologists and researchers in the coming decades.

According to the program literature, a strength of the Summer Undergraduate Research Program is the presence of the Colleges of Biological Sciences, Agriculture, Food and Environmental Sciences, and Natural Resources, as well as six Health Science Colleges at the University of Minnesota. With more than 1,200 faculty members who teach and advise graduate and undergraduate students in biological science disciplines, a wealth of faculty expertise provides a basis for a variety of summer research programs for undergraduates. In this particular summer program, undergraduates participate in ongoing research projects in a wide variety of disciplines in basic biological sciences. The disciplines advertised to the students for study include: animal biology, behavioral biology, biochemistry, bioengineering, biotechnology, cell biology, ecology, entomology, environmental biology, genetics, microbiology, molecular biology, neuroscience, nutrition, pathobiology, pharmacology, physiology, and plant biology.

The program has been offered since the summer of 1989 with 474 student participants

through 1995 (Table 1). Of the participants during this time period, 193 summer undergraduate research positions (41%) were held by students of color. Included in the program's students of color group are African American, Latino, Native American, Asian and Pacific Island students. Female students held 64% of the summer research positions.

Table 1

Demographic Data on SURP Participants 1989-1995

Summer Year	1989	1990	1991	1992	1993	1994	1995	Total
Total Students	16	51	61	96	88	69	93	474
Female Students	13	34	38	60	57	40	63	305
Male Students	3	17	23	36	31	29	30	169
Students of Color	12	23	29	34	35	33	27	193

Source: SURP program files

Participating students must have completed basic course work in chemistry, biology, and physics, and must have an undergraduate grade point average of 3.2. Program participants must commit themselves to at least two months of full-time research activity. During the summer, the students are involved in four types of research related activities:

1. Assisting a faculty mentor on his or her current research, including opportunities to work as a member of a research team,
2. completing an independent research project under the direction of the same faculty mentor,
3. participating in a weekly seminar complementing the laboratory and field activities, and
4. preparing a summary of the research project findings in the form of a display for a campus-wide poster session.

Students have the opportunity to learn specific research methods, to apply these methods in the context of their own research, and through student seminar presentations to develop skills in communicating their research results. In most of the summer programs since 1989, student seminar presentations were videotaped to provide feedback on improving oral communication skills. In recent summers, approximately 30 of the student participants took three weeks of course work in molecular biology or neuroscience followed by seven weeks of laboratory research in these areas.

The program provides undergraduates a stipend of $250-$300/week and is open to students from all colleges in the United States and its territories. A small number of housing allowances is available for room and board and a significant portion of the funding is targeted to providing opportunities for women and students of color. Students of color are actively recruited through contacts with faculty at Historically Black Colleges and Universities, Tribal and Hispanic serving institutions, attendance at the annual National Institutes of Health-National Institutes of General Medical Sciences Minority Research Symposium and the mailing of flyers and posters to campuses.

From the earlier years (1989-1992) of the program, 62 to 72% of the program's participants have completed or are enrolled in graduate or professional programs. The data from 1993 and 1994 showed fewer summer participants were in graduate/professional programs because these recent participants, many of whom participated in the summer program as sophomores and juniors, have not received baccalaureate degrees by the spring of 1995. As of fall 1995, 65 under-represented minorities were enrolled or had completed graduate/professional programs.

Subjects

The program participants are unique and distinctively talented and gifted students in the sciences. The selection of study participants was purposeful and non-random (Bogdan and Biklen, 1982). The particular subjects are included because they are believed to facilitate the expansion of developing theory about recruitment and retention of students of color into graduate and professional science degree programs. Program data show that 474 students participated in the SURP between 1989 and 1995. For this study, the initial subject sample consisted of 136 African American, Latino and Native American and 65 of the 268 Caucasian students who had participated in the program from 1989 through 1995. This sample by race/ethnicity and gender consisted of:

Caucasian			
23 males	42 females	65	
Latino			
19 males	28 females	47	
African American			
24 males	54 females	78	
Native American			
4 males	7 females	11	
70 males	131 females	201	Total Sample Population

Methodology

Two sources of data were used to determine the extent of academic and social integration experienced by the selected sample of students from the Summer Undergraduate Research Program. To obtain quantitative data a modification of the Institutional Integration Scale developed by Pascarella and Terenzini (1980) to operationalize Tinto's model of student attrition was used. Analysis of responses to the Institutional Integration Scale presented a rather detailed

picture (Figures 3 through 5) of the characteristics of the sample of SURP participants, while documenting that 92% of the 108 survey respondents have received, are pursuing, or planning to pursue a graduate or professional degrees in science or mathematics. The results of the statistical analysis suggested that there were individual, program and institutional factors that influence student decisions about graduate/professional programs and careers.

To obtain qualitative data, open-ended interviews were conducted with fourteen SURP alumni. The interview questions probed for themes related to preparation of the alumni for the roles of graduate students and professional students. The alumni interviewed included twelve alumni enrolled in undergraduate, graduate and professional programs at the University of Minnesota and other Twin Cities area colleges; one alumna enrolled in graduate school in another state and one SURP alumnus who had graduated from the University of Minnesota with a Master's degree and had remained to work in the Twin Cities area. The student status, sex and racial/ethnic identity of the interviewees follow:

Table 2

Student Status, Sex and Racial/Ethnic Identity of Interview Sample

Racial/Ethnic Identity	Male	Female
White	M.D., M.D.	M.D./Ph.D., M.D.
Hispanic	Ph.D., M.D./Ph.D.	UG, Ph.D., Ph.D.
African-American	M.S. graduate	UG, UG, UG, M.D.

The one-to-one interviews were conducted from July through October of 1996. The questions focused on the socialization of these individuals to the role of graduate and professional students and to their professional positions. Sufficient flexibility was built into the interview protocol to

permit a spontaneous flow of responses, so that some of the interview topics were more widely discussed by some participants than others. Each interview session was audio taped and the tape transcribed.

This paper focuses on the results of the analysis of qualitative data gathered from the interviews.

Qualitative Data Analysis

Data from the open-ended interviews were analyzed for recurring themes related to social and academic integration and to the SURP experience. The analysis followed an inductive approach to generate grounded concepts for interpreting the context within which the SURP participant made persistence decisions. The analysis of the interviews began with open-coding of the interview transcriptions, that is, coding of their contents in as many ways as possible. The coding categories related to subjects' definitions of situation and subjects' ways of thinking about people, processes, activities, events, strategies, relationships and social structure. The saliency of the categories, as judged by frequency of occurrence, uniqueness, and apparent connectedness to other categories, was the criterion for decisions to retain, merge, and/or discard coding categories.

The major themes and subthemes of the interview questions were:

1. Interaction with SURP faculty mentors, student mentors and program staff
   a. SURP mentors and faculty
   b. SURP administrative staff
   c. Student-faculty informal contact of the SURP
   d. The one person who made me feel like I belonged in the SURP

2. The SURP experience--overall, academic and social
   a. SURP overall environment

b. SURP academic/instructional environment
c. SURP social environment/SURP peers
d. Disappointments with SURP

Interview Findings

Interactions with SURP Faculty Mentors and Program Staff

Student interaction with faculty and peers is said to influence educational achievement (Pace, 1990; Pascarella & Terenzini, 1991). The summary of themes displayed in Table 3 indicate how important interactions with faculty and program staff were for program participants.

Table 3

Interactions with SURP Mentors, Faculty, Lab Co-workers & Program Staff

Number of References to Themes During Interviews*

Themes	White	African Amer	Latino	Total
Supportive Mentors (Faculty & Students)	14	10	9	33
Problems with Mentors (Faculty & Lab Co-workers)		5	4	9
Supportive Program Coordinator & Staff	10	7	10	27
Positive Faculty-Student Informal Contact	2	5	3	10
Negative or Neutral Faculty Student Informal Contact	2		1	3
SURP Peers as Context of Discussion	1	1	1	3

*The numbers displayed in this table indicate the number of times the interviewees mentioned the identified theme.

For those participants new to the University of Minnesota campus, having positive, supportive interactions was cited as a most important factor in their success in the program. The interviewees who had been undergraduates at the University of Minnesota indicated that the SURP allowed them to have a more in depth research experience. At least eight of the interviewees had previously worked in the laboratory of their mentor or they continued to work with the mentor as undergraduate or graduate students after the summer program ended. This influenced their academic and individual maturation. For most of the interviewees the faculty mentor relationship was very positive, with a strong influence on academic and career choices. A few of the interviewees cited relationships that didn't work because of mentor's schedule, mentor's lack of familiarity with the role of supervising and guiding undergraduates through meaningful research and the SURP participant's reluctance to assertively negotiate changes to improve the faculty mentor-student relationship. This reluctance was most often based on the SURP participants perception of their place in the academic hierarchy.

Comments pointed out that not only was the faculty mentor an important participant in the SURP alumni experience, but the interactions with employees and graduate students in the assigned laboratory influenced the alumni's research project outcome and perception of self as a researcher. The themes mentioned most often across the three subgroups interviewed (white, African American, Latino) were the importance of having supportive mentors and the importance of having supportive and accessible program staff. The importance of student faculty informal contact was third in frequency of being mentioned by interviewees.

The traditional structure of student advising has students receiving program information from program directors, student counselors, etc. Comments from interviewees indicated that they

appreciated having graduate student involvement in the SURP program activities or present in the laboratories. While all relationships were not smooth, the interviewees identified with people (graduate students) who had recently experienced the decision-making process that the SURP participant would soon be going through.

SURP Administrative Staff

Practically all of the interviewees provided glowing comments on the involvement of administrative staff throughout the program from the recruitment process to the end of the program poster session, closing dinner and post-program academic year updates by mail. SURP interviewees who were less involved with administrative staff were Twin Cities students who had familiarity with the university and/or the research laboratories prior to participating in the program. These Twin Cities residents were more likely to live off campus and to have less involvement with staff in relation to social and out-of-lab activities.

The interviewees' comments spoke of the importance of having a program staff that was accessible, physically and electronically; a staff that maintained a visible presence for participants and provided immediate follow-up for participant concerns. Another important characteristic of the staff was the inclusion of graduate students in different capacities. This provided peer connectedness for the SURP participants. The undergraduates saw graduate students holding leadership roles in program activities and had access to graduate student who were further along in the science career path than they were.

Student-Faculty Informal Contact of the SURP

Various studies have been done on within-college sources of influence on student development. Pascarella and Terenzini conclude, however, that "the degree of change in

intellectual orientation appears more clearly to be related to the socializing influences within various college settings that involve interactions of people--students and faculty members" (1991). Comments from interviewees were positive about informal activities as a way of showing that the faculty, while respected for their research accomplishments and academic roles, could interact with students at an academic and social level. A comment from one interviewee follows.

> For me, I come from a society which professors, even outside of the classroom, you have to call them doctor. So, when you come to the American society which is a little bit more laid back, it was a terrific experience for me. After they close the door, most faculty members are just like me. At the same time, it provided me with great interactions. Actually, one of the faculty members that I met during my second summer session is just a great friend of mine now. **(Hispanic male)**

The One Person Who Made Me Feel Like I Belonged in the SURP

The interviewees ability to make a personal connection between their interests, goals and the summer program was shown in comments regarding the one person who made them feel like they belonged in the summer program. Most often interviewees cited the program director because of the director's presence, accessibility and quick response in problem solving for program participants. The program director as a knowledgeable, personable and available resource seemed to be more important to SURP participants from other campuses than for University of Minnesota undergraduates participating in the program. A comment from one interviewee follows.

> *Program coordinator.* No question about it. It was that first year. She really went out of her way to make me feel like I was at home, to even make like a Puerto Rican dinner and she invited all the Puerto Ricans that were around that she knew. . . . but within the program, she was always there. If you needed a call, if you had a question, if something wasn't working out. She really was the person that I would have to mention. **(Hispanic male)**

SURP participants' references to the importance of the role of the program coordinator are noted as an important program feature. A study (Crosson, 1987) of environmental factors that relate to minority degree achievement in predominantly white four-year colleges and universities noted the critical role played by program staff. Crosson found that "a few dedicated (often minority) staff members in a very few units were making the critical difference to minority student success."

The SURP Experience--Overall, Academic and Social

Table 4 provides a summary of the themes from interviewees on the overall SURP experience. The majority of the interviewees felt that the SURP was a stimulating program that was balanced in addressing academic and social needs.

Table 4

The SURP Experience--Overall, Academic and Social

Number of References to Themes During Interviews*

Overall Project Themes	White	African American	Latino	Total
Supportive Environment	1	2	2	5
Academic Development & Graduate Research Preparation	2	1	2	5
Stimulating, Balanced Emphasis		1	2	3
Importance of Good Advisor	1	1		2
Academic Environment Themes				
Professional & Beneficial	4	3		7
Enhanced Skills & Abilities	3	2	1	6
Graduate School Choice as U of Minnesota	1	1	2	6
Peers contribution to Academic Environment	3	2	1	6
Social Environment Themes				
Enjoyable Social Environment		5	5	10
Negative/Neutral Social Environment**	3		1	4
Loved Peer Group Interactions	4	9	4	17
Found Limited Peer Group Interactions**		4		4
Ethnic Group Clustering		2	2	4

*The numbers displayed in this table indicate the number of times the interviewees mentioned the identified themes.

**These comments were made by participants living off campus.

SURP Overall Environment

All of the interviewees felt supported by the overall environment of the summer program. If some aspect of the program such as the mentor relationship presented difficulty, the interviewee compensated by finding satisfaction in other aspects of the program, such as the research project itself, the graduate school preparation seminars or the close relationships that developed with peers. In comments on the overall environment, positive interactions with peers, program staff and faculty mentors were frequently mentioned. These references to positive personal interactions were more numerous than comments about specifics of the laboratory research experience. Again the importance of peers was an underlying theme for interviewee responses to discussion topics. Only one interviewee gave a somewhat negative response to the overall experience. From the context of the comment, the interviewee was referring to attending the university as a full-time student rather than as a SURP participant. This interviewee was disappointed that the peer support experienced in the SURP was never duplicated after transferring to the university as an undergraduate. Comments about the overall environment follow:

> Overall environment, just really great. I think about the environment of my work and there were days when I just didn't want to go to work, but I loved my project. I really was truly interested in my project, even though the people I had to work with weren't that great. I was generally interested and I was excited to go to work. But also, I was excited to participate in the other programs and go to these GRE seminar classes because I would see everybody there. that was very good for me. But the overall environment, it was just really stimulating. **(Hispanic female)**

> The overall environment was pretty good. Again, the relationships that I developed with the students would sort of offset any problems that you may be having in the lab, so there was definitely a balance. Especially, if you had a good advisor. **(African American male)**

> The great thing about the summer program was that it wasn't just research. My previous programs were basically just going to my lab. No real interaction with the rest of the people in the program. This had its own seminars. It had its weekly event things that were supposed to go to. It had its GRE classes and its writing workshop that you saw the other members and you're also being exposed to all these other ideas in the world. It wasn't just going to a lab and working 9 to 5. **(African American female)**

SURP Social Environment/SURP Peers

A big difference was noted between interviewees who lived off campus during the program and those who lived on campus or made the effort to establish ties with participants residing on campus. The interviewees who lived off campus reported very little involvement in the after work social activities and not as much bonding with summer program peers. The interviewees who lived on campus and one interviewee living off campus repeatedly talked about how important to the program and to their lives they saw the friendships that they developed with peers. Even when responding to other questions, interviewees would comment on the friendship they developed, how they were supported by their friends and how the friendships have been maintained since the SURP experience. Interviewees commented on being glad of and enjoying the diversity of their colleagues with comments on how their group of close friends from the program represented a mixed group. Other responses referenced how some groups formed around racial or ethnic identify. The African American interviewees referenced the importance of inter-racial contacts, but spoke most often about the positive nature of the support from other African American program peers. One African American interviewee, with a positive reference to the diverse friendships made during the program, felt that the same race grouping of friends was a strength of the program. Another interviewee, now working in the program, wanted more intermingling of racial/ethnic groups during the summer program. The SURP peer relationship

was so positive that one interviewee was disappointed that the level of peer support that she experienced in the summer program was not duplicated when she transferred to the university to finish her undergraduate program.

Racial/Ethnic Identity of Program Participants and Interviewees

The racial/ethnic identity of program participants was indicated to not be an issue for Caucasian SURP interviewees. Some SURP alumni of color saw their participation as a welcomed opportunity to have advanced work and to make connections that could lead to graduate or professional school. African American and Latino student reported more personal mismatches with mentors or hearing of peers having problems with faculty mentors. In all instances except one, problems of incompatibility with mentors were reported by female interviewees.

African American and Latino interviewees spoke more often and more dramatically about peer relations. Five of the ten persons of color interviewed were from areas where their race/ethnicity was represented in larger numbers, perhaps they were surprised that Minnesota would have a program where they could find peers of the same racial/ethnic background with similar academic interests.

Few disappointments with the program or frustrations with the program structure were expressed. But, persons with disappointments or frustrations with the program or with their progress along the science pipeline would probably be more reluctant to participate in the interview.

Summary of Findings

The study's overall purpose was to answer the question, "What retains minority students in the graduate/professional science degree pipeline?" The information cited in the literature survey provided an understanding of why minority student achievement and performance in science and mathematics differ from that of majority students. The qualitative analysis of the interviews led to supportive findings about minority student retention.

Interviews with 14 majority and minority SURP alumni provided information that identified factors and characteristics of the summer program that positively affects the graduate and professional science program enrollment of students. Interviews with four Caucasian, five Hispanic and five African American SURP alumni indicated that all felt that the research program had positively affected their academic program, choice of graduate or professional programs and career choice. Overall, the interviewees indicated that the following program characteristics were important to them -- the advanced research experience, information about graduate and professional school programs, the acclimation to graduate research work, establishing close friendships with peers and developing mentoring relationships with faculty and program administrators. All interviewees were enrolled in, graduates of, or had plans to enroll in graduate or professional programs.

Since interviews were limited to SURP alumni in the Twin Cities, the minority alumni available for interview included some undergraduates consenting to be interviewed and not as many minority graduate program alumni. This developed because as previously mentioned minority summer program participants tended to be in the early years of their college experience more so than white program participants. Four of the ten minority interviewees were

undergraduates. With career goals in public health administration, environmental science, research science and the medical field, the minority interviewees indicated that the following program characteristics influenced them to plan or pursue graduate or professional school studies.

- the development of supportive peer relationships,
- mentors from the faculty, their research lab, the program administration or their seminar group that helped them grow professionally, and
- an overall program structure that challenged them and validated that they were capable of graduate or professional school work

Conclusions

The qualitative findings from this study support Tinto's assertion that social integration (involvement with peers, faculty and campus activities) is an important factor in furthering student persistence. Students of color spoke most often about the importance of positive relationship with peers and faculty and how these positive relationships influenced their decisions about continuing in graduate and professional programs. The process of persistence in college is viewed as a process of social and intellectual integration leading to the establishment of competent membership in college and professional communities. Turner and Thompson's (1996) study of the socialization experiences of minority and majority women in graduate education programs pointed out that a successful socialization process is critical for a successful graduate career. Results of this study indicate that successful socialization is a critical component in preparation for graduate and professional careers.

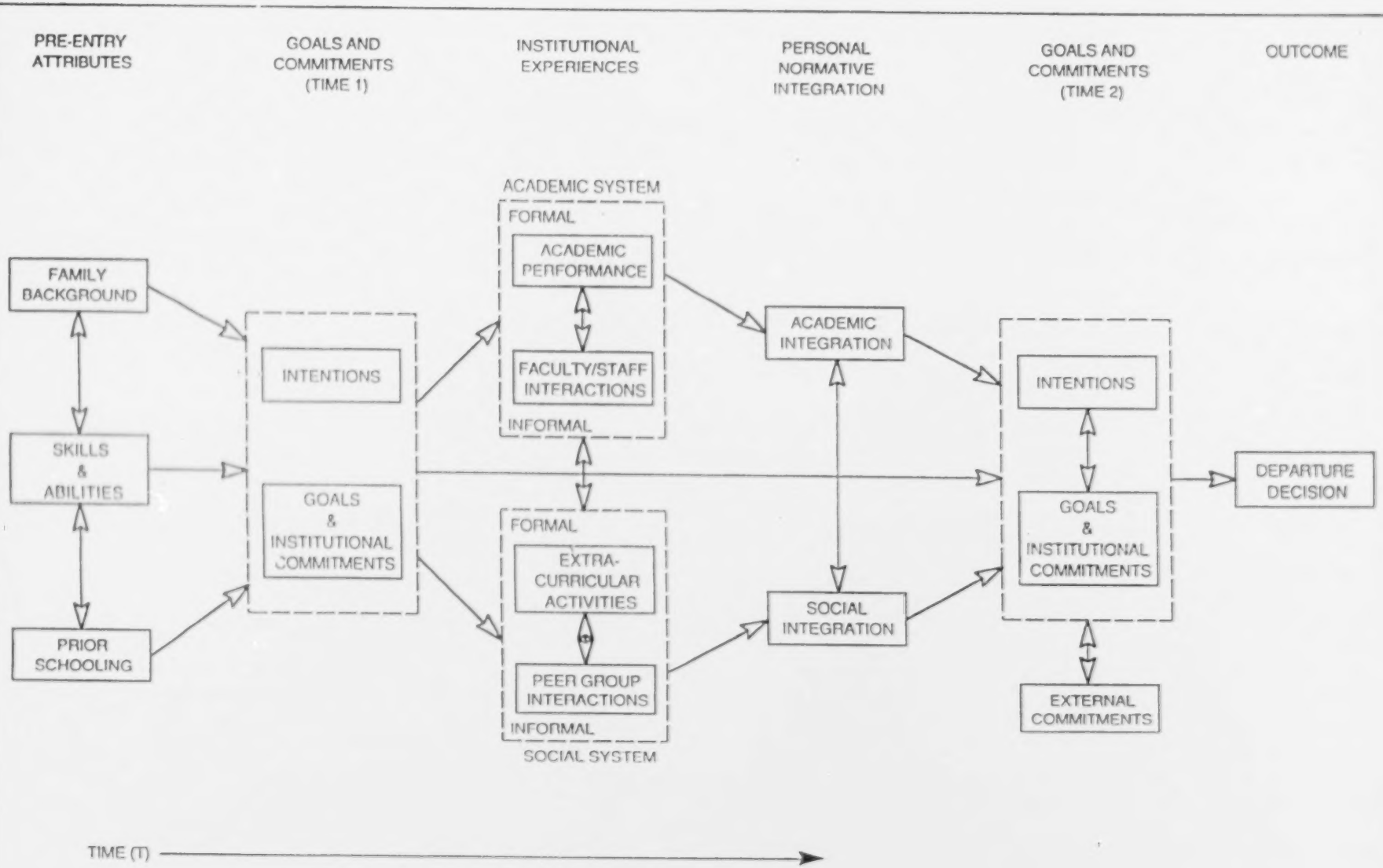


Figure 1 *Tinto's Model of Student Development*

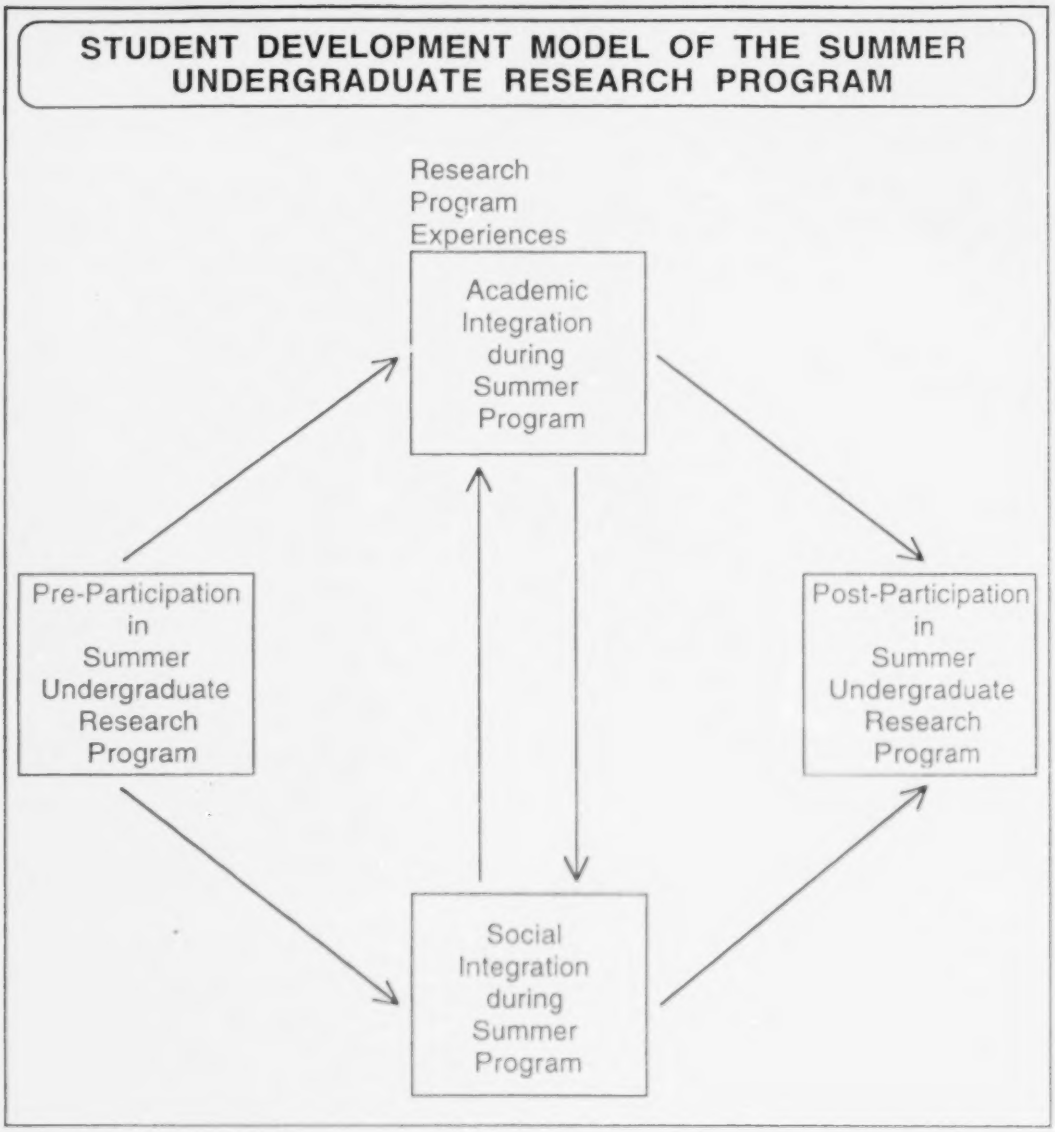
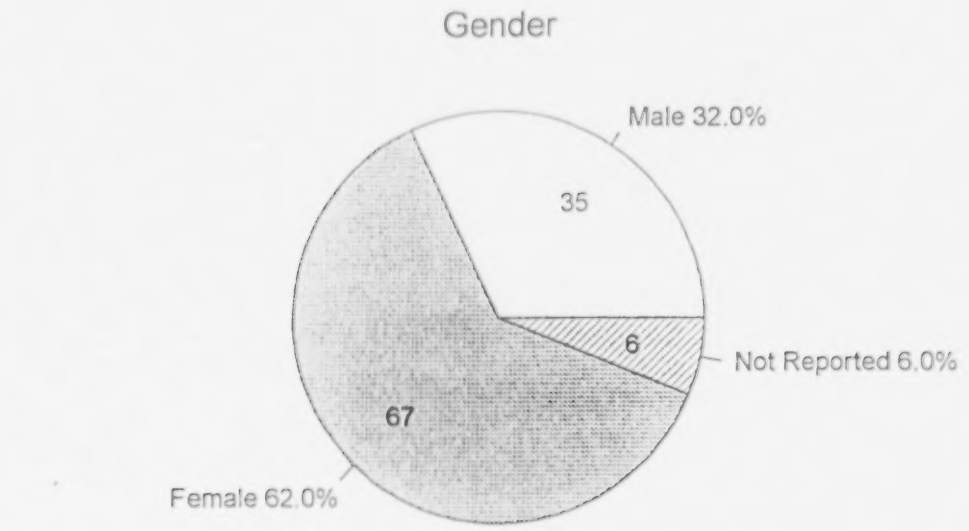
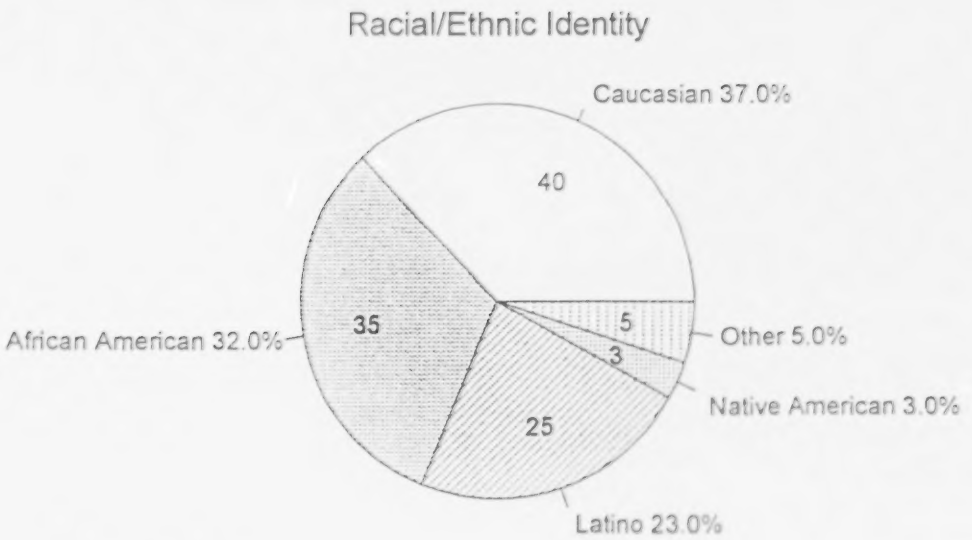

STUDENT DEVELOPMENT MODEL OF THE SUMMER UNDERGRADUATE RESEARCH PROGRAM
Research Program Experiences
Academic Integration during Summer Program
Pre-Participation in Summer Undergraduate Research Program
Post-Participation in Summer Undergraduate Research Program
Social Integration during Summer Program

Figure 2

Demographic Information on Survey Respondents





Figures 3

Demographic Information on Survey Respondents

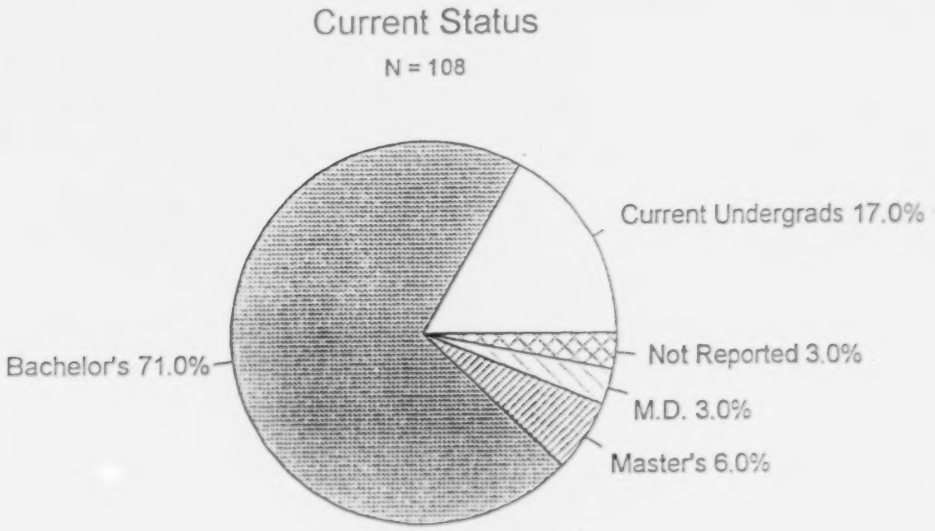
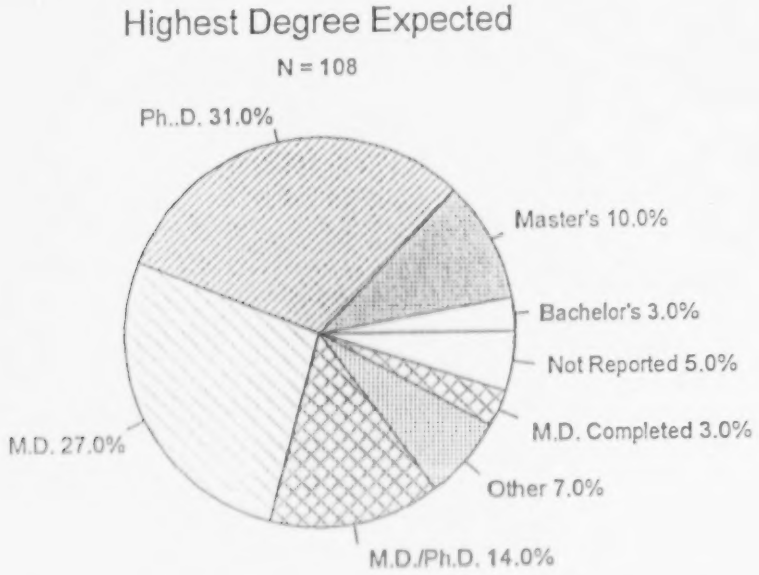
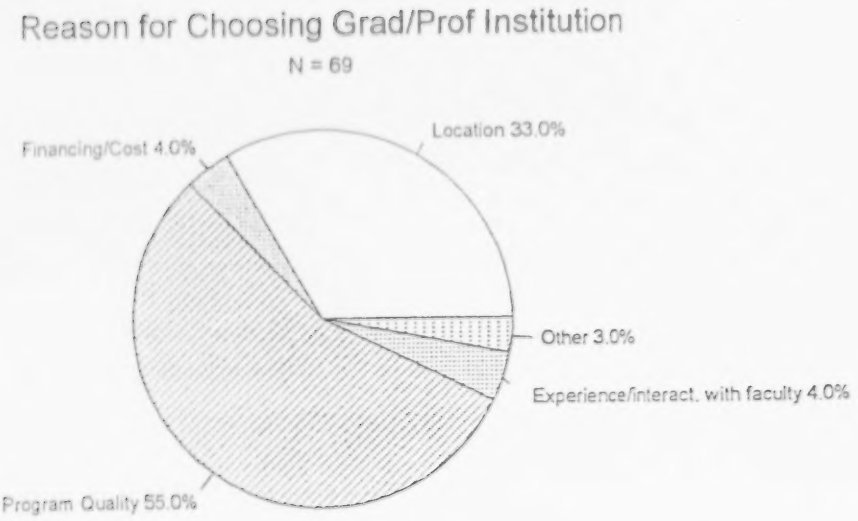


Figure 4


Highest Degree Expected
N = 108
Ph..D. 31.0%
Master's 10.0%
Bachelor's 3.0%
Not Reported 5.0%
M.D. Completed 3.0%
Other 7.0%
M.D./Ph.D. 14.0%
M.D. 27.0%


Reason for Choosing Grad/Prof Institution
N = 69
Location 33.0%
Financing/Cost 4.0%
Other 3.0%
Experience/interact. with faculty 4.0%
Program Quality 55.0%

Figures 5

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